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CHAPTER 7

SOUND-POWERED COMMUNICATIONS

169. Introduction

As previously explained, the carbon-button transmitter and the magnetic-diaphragm receiver involve the use of batteries as the initial source of power, when used as basic components of various telephone systems. Externally supplied power is necessary, because the carbon-button transmitter is not a generating device; it operates on the principle that varying resistance in a chamber of carbon granules causes corresponding variations in a direct current initially produced by a battery in the circuit. For certain applications, it is desirable to communicate by telephone without the use of batteries. A *system* that permits this is called a *sound-powered system* (or *batteryless system*).

170. Sound-Powered Transmitter

a. Structure. The structure of a *sound-powered transmitter* is indicated in the simplified diagram of figure 201. This transmitter has a permanent magnet with double pole pieces N-N and S-S, representing the north and south poles, respectively. In the space between the opposite poles is coil C, wound around a soft-iron armature. The armature is pivoted near its center, P, so that it is free to rotate vertically to a limited extent in either direction. A diaphragm is connected mechanically to the armature by means of coupling rod R. This permits motion of the diaphragm to be transferred to the armature, so that, as the diaphragm moves downward, the armature rotates slightly counterclockwise, and as the diaphragm moves upward, the armature rotates slightly clockwise. Adjusting screw SC limits downward travel of the armature. Terminals 1 and 2 terminate the line.

b. Operating Principle. The operation of the sound-powered transmitter is based on the fundamental principle of electromagnetic induction, as explained in TM 11–681; that is, the value of the induced emf depends on the number of turns linking the flux and the rate of change of flux, according to the formula,

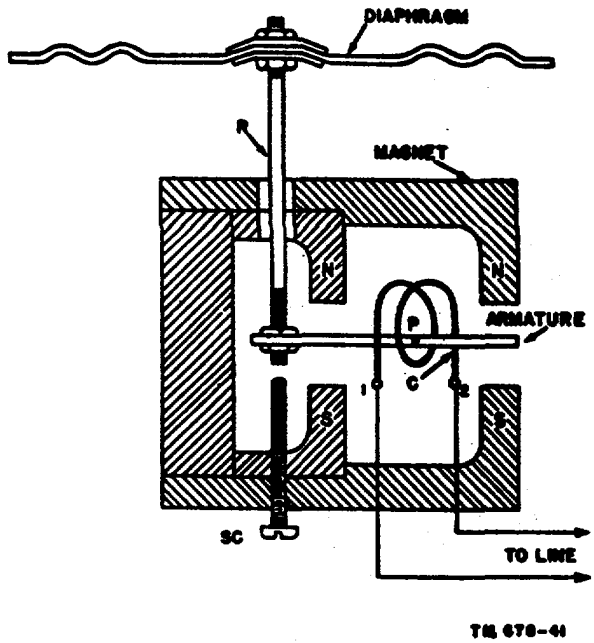

Figure 201. Sound-powered unit.

$$e = -\frac{Nd\phi}{dt} \times 10^{-8}.$$

The motion required to change the flux linkages is derived from the acoustical power driving the diaphragm.

171. Operation

a. Assume that the transmitter diaphragm is moving up and down at a rate corresponding to a single-frequency, sine-wave audio note. Figure 202 shows 1 cycle of this action. When the diaphragm is at its maximum downward position, as in A, the induced voltage is zero, since the movement of the armature has stopped momentarily and the rate of change of flux is zero. As the diaphragm then swings upward through its center position, as in B, the rate of change of flux is at a maximum, since it is changing direction; that

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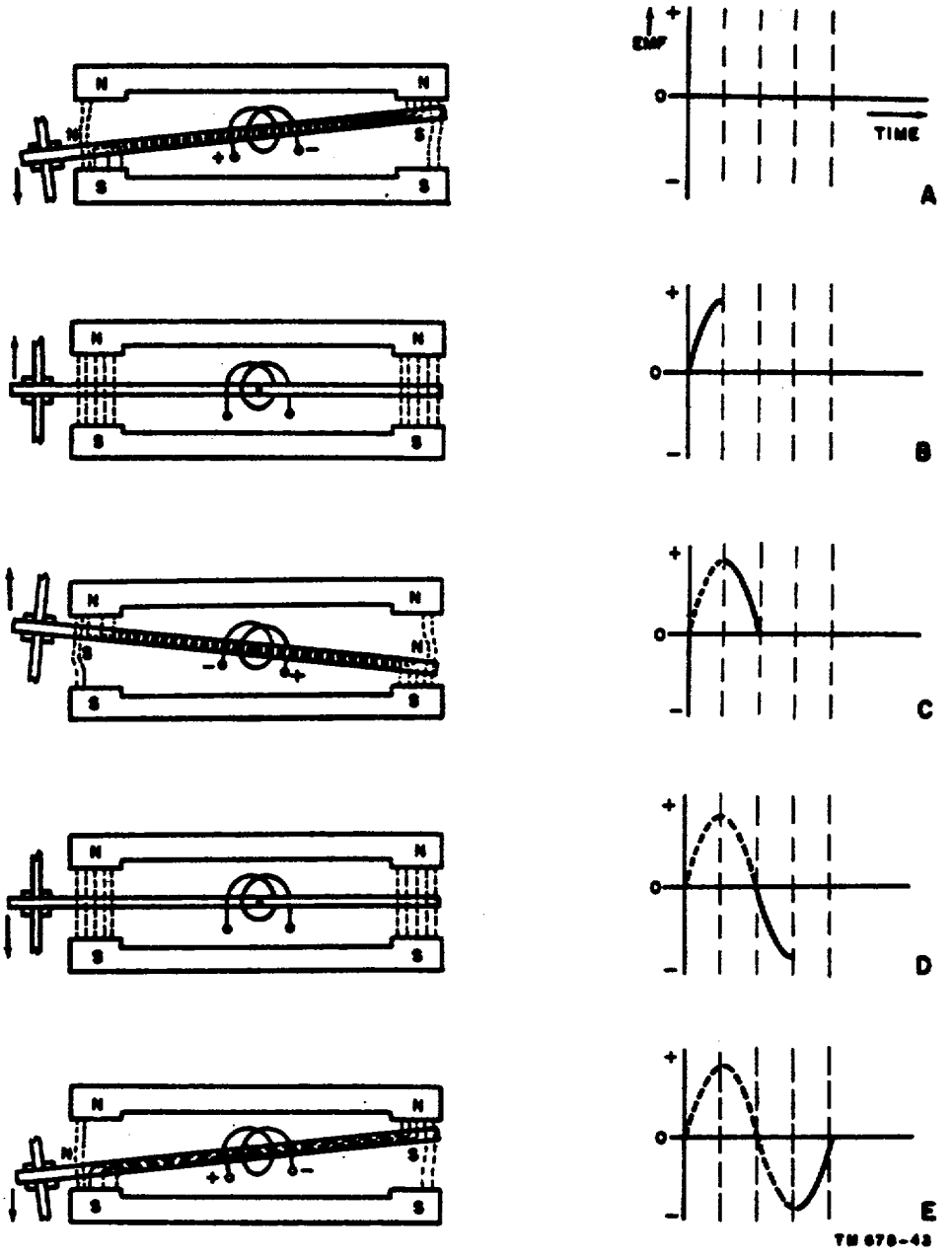

Figure 202. Electromagnetic induction in sound-powered unit.

is, the S pole of the armature becomes N and the N pole becomes S. The induced voltage is, therefore, a maximum. As the diaphragm stops momentarily at its maximum upward position, as in C, the induced voltage again becomes zero, since the rate of change of flux is zero. Continuing through the rest of the cycle, as the diaphragm passes its center position again, as in D, but from the opposite direction, the induced voltage is a maximum in the opposite direction. The induced voltage is zero again as the diaphragm again reaches its maximum downward position, as in E. This action repeats for succeeding cycles of the audio note.

b. The illustrations of figure 202 refer to a simple sound wave of a single frequency. When the sound waves striking the diaphragm are *complex*, as is always the case with speech sounds, the vibrations of the armature also are complex. If the transmitter is designed so that its response to all

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frequencies in the speech range is essentially the same, the waveshape of the induced emf will be a faithful reproduction of the waveshape of the sound striking the diaphragm. Therefore, the operation described applies to complex waves as well as to simple waves.

c. The alternate counterclockwise and clockwise rotation of the armature results in the induction of a corresponding emf in the coil. This is true whether the ends of the coil are open-circuited (not connected to an external load) or terminated in a load. If the coil is not connected to a load, no current will flow in the coil. However, when a load, such as a transmission line terminated by a receiver, is connected to the coil, the induced emf causes an alternating current of similar waveshape to flow in the coil, in the line, and in the receiver.

172. Sound-Powered Receiver

a. Structure. The structure of the *sound-powered receiver* is identical with that of the transmitter described in the preceding paragraphs. The same unit therefore can be used either as a transmitter or a receiver in a sound-powered system.

b. Operating Principle.

(1) Although the sound-powered receiver is identical in structure with the sound-powered transmitter, the principle on which its operation is based is different. A, figure 203, indicates that when a coil is wound around a soft-iron armature, and current is introduced in the coil, a magnetic field builds up around the coil. The magnetic lines of force through the armature make it an electromagnet. When the north pole of this electromagnet is brought near the south pole of another magnet, a force of attraction is produced and, if the electromagnet is pivoted at its center so that it is free to rotate, the force of attraction causes a counterclockwise rotation of the electromagnet shown in B. If the north pole of the electromagnet is used instead, a force of repulsion will be produced, causing a clockwise rotation of the electromagnet. The sound-powered receiver contains an electromagnet (acting as an armature) moved by forces of both attraction and repulsion.

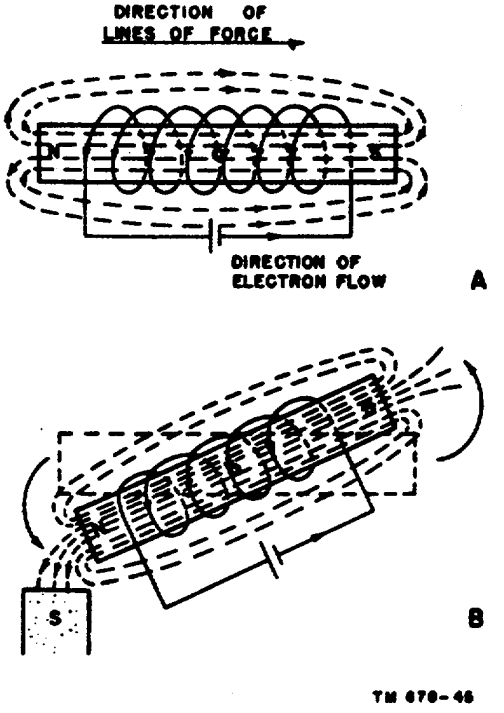

Figure 203. Magnetic field around current-bearing solenoid.

(2) The polarity of an electromagnet can be determined by applying the following rule: When the coil is grasped with the *left hand* so that the fingers encircle it in the direction in which the electrons are moving, the outstretched thumb points in the direction of the north pole.

173. Operation of Sound-Powered Receiver

The application of the electromagnet principle to the sound-powered receiver is shown in figure 204.

a. The single cycle of alternating emf induced in the coil of the transmitter unit, as previously stated, causes an alternating current to flow through the transmission line into the coil of the receiver unit. At the beginning of a cycle, when the current has zero value, as in A, no magnetic field is produced around the armature (electromagnet) and, consequently, it exhibits no polarity. No interaction takes place between the armature and the permanent magnet, and the armature is at its horizontal, *in-between* position of rest. The armature is coupled to the diaphragm in such a manner that it also has its in-between position of rest.

b. The current now begins to increase, as in B.

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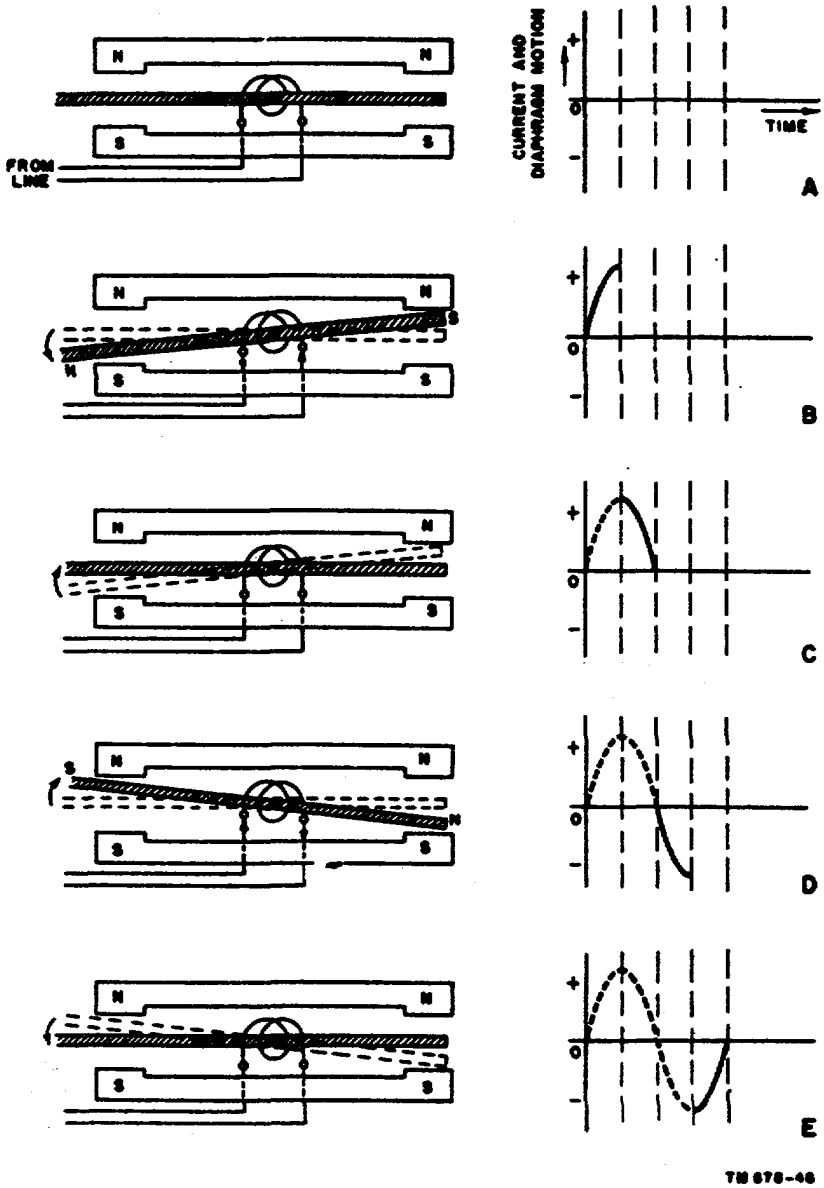

Figure 204. Action of sound-powered receiver.

Assume that the direction of the current is such that the left end of the armature becomes a north pole. The armature rotates counterclockwise, its left end moves downward, being repelled by the left north pole and attracted by the left south pole of the permanent magnet, and, at the same time, the right end of the armature (now a south pole) moves upward because of a similar interaction with the permanent magnet. As the current approaches its maximum value, the downward displacement of the left side of the armature and the diaphragm to which it is coupled mechanically approach maximum.

c. After reaching its maximum value, the current, though still flowing in the same direction, decreases toward zero, as in C. As it does so, the magnetic field around the armature decreases or becomes weaker, and thus the forces acting to rotate the armature are diminished. When the armature is moved from its normal position in either a clockwise or a counterclockwise direction, a force is transmitted from the armature to the diaphragm through the mechanical coupling, R (fig. 201). This force will cause the diaphragm to bend at its center in a direction determined by the direction of the applied force. As the forces

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diminish between the permanent magnet and the armature, the diaphragm tends to return to its normal position; in doing this, it acts through the mechanical coupling to restore the armature to its normal position.

d. The current now changes direction and begins to increase negatively in magnitude, as in D. The change in direction reverses the polarity of the electromagnet, the armature rotates clockwise, and the left end moves up from its in-between position of rest. When the current becomes maximum in this opposite direction, the diaphragm reaches its maximum upward displacement.

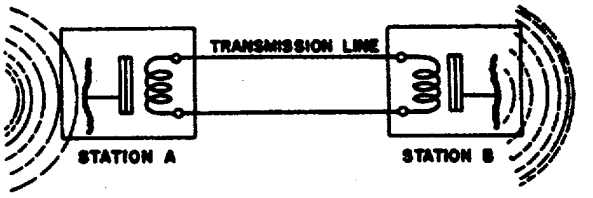
e. After reaching maximum, the current again begins to decrease toward zero, as in E. The strength of the armature field diminishes, allowing the armature to be returned toward its neutral position. The left end of the armature and the diaphragm move downward until, at the instant the current reaches zero, they again reach their in-between position of rest. This instant coincides with the end of a complete cycle of current, armature motion, and diaphragm displacement.

f. Thus, the diaphragm vibrates down and up in accordance with variations of current in the receiver coil. Successive vibrations of the diaphragm produce alternate condensations and rarefactions of the adjacent air particles, and so generate sound waves having variations of amplitude and frequency which correspond to those of the current waves. Since the current waves are of the same form as the voltage waves generated at the transmitter, the sound waves produced by the vibration of the diaphragm of the receiver are essentially of the same waveshape as those introduced at the transmitter.

g. The explanation just given is based on the flow of a simple sine-wave current, but the operation of the sound-powered receiver is essentially the same for the actual complex waves involved in the transmission of speech.

174. Simple Sound-Powered System

An extremely simple sound-powered system suitable for two-way communication may consist of two identical sound-powered units connected by a transmission line (fig. 205). The transmission line is connected to the coils of the two units at stations A and B. Operation requires no battery or other external source of power. For conversation, each person uses his unit as a transmitter when he wishes to speak, and as a receiver



TM 676-47

Figure 205. Simple sound-powered system.

when he wishes to hear the works spoken at the other end of the line. However, an important component of a practical telephone system is missing—a means for signaling or ringing to initiate a conversation. This omission makes the system impractical, except for special applications where signaling is not important. Crews installing tower antennas, for example, may use sound-powered systems for convenient communication between the tower and the point where the set is being adjusted.

175 Practical Sound-Powered System

a. Description. The *practical sound-powered telephone circuit* shown in figure 206 consists of three parallel branches. One branch contains a sound-powered handset in series with the line through capacitor C1; the second branch contains the ringer in series with capacitor C2 and a neon lamp; the third branch contains a hand generator.

(1) The handset is connected permanently across the line in series with capacitor C1, usually of .5-μf capacity. Since the impedance of this capacitor is relatively high at low frequencies, capacitor C1 limits the low-frequency signaling current through the handset and blocks dc. However, at voice frequencies, C1 has a relatively low impedance and does not limit the voice-frequency currents appreciably.

(2) The ringer, capacitor C2, and the neon lamp which constitute the second parallel branch operate on 16- to 20-cycle ac. Screw switch S1 permits the lamp to be shorted out, making possible the use of either lamp or bell for signaling, to suit the tactical situation. When the switch is in the (open) position indicated, the lamp is in series with capacitor C2 and the ringer. Since the lamp offers a rela-

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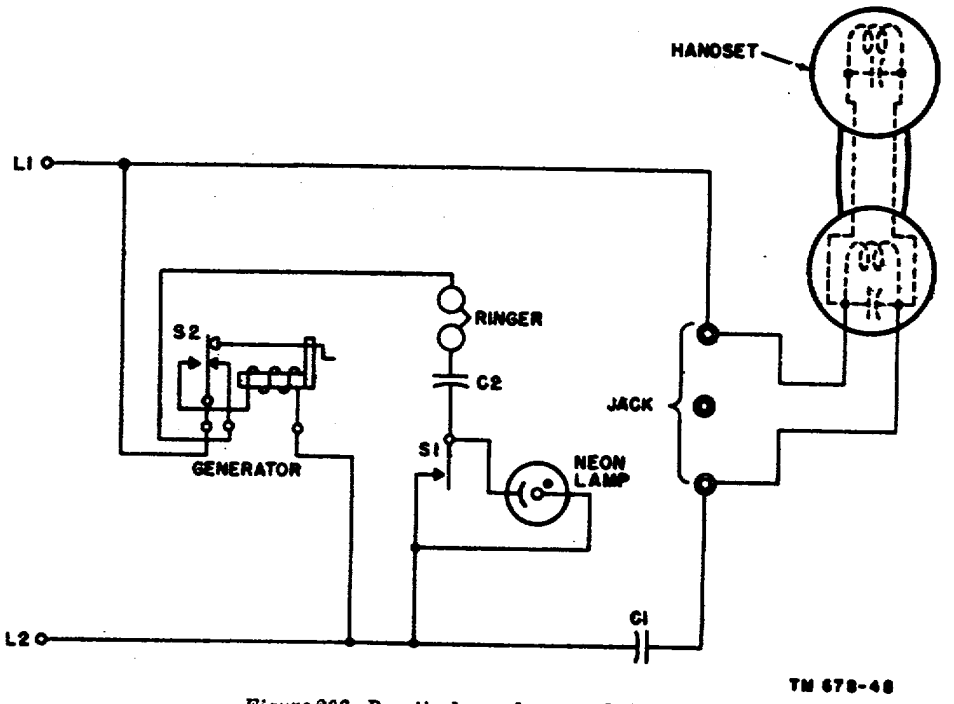

Figure 206. Practical sound-powered circuit.

tively high impedance to the ringing current, the ringer will not operate in this position; however, because the lamp requires only a small current to operate, it will light when ringing current from a distant telephone is applied. When the switch is thrown to the other (closed) position, the lamp is shorted out and the ringer will operate. The inductance of the ringer circuit offers low impedance to the low-frequency ringing current, but high impedance to the voice-frequency currents; consequently, it does not interfere with voice transmission. Capacitor C_2 is usually of 1.9-μf capacity. It is used to prevent dc from magnetizing the ringer coils and interfering with proper operation. It also helps to balance the line impedance.

(3) The third branch contains a generator used to generate the low-frequency ringing current for signaling the distant telephone. The generator switch connects the generator across the line and disconnects the adjoining ringing circuit, so that the ringing current produced by the generator cannot pass through the ringer of the same telephone. The indicated position of the switch shows the generator removed from the line for normal operation of the talking circuit. The generator is of the magneto type previously described.

b. Normal Operation. For normal operation in a practical sound-powered system, two sound-powered handsets are connected to form a complete circuit. When the telephones are used on a two-conductor line (a metallic circuit), the ends of the conductors are connected to binding posts L1 and L2 at each end of the line (only one pair shown in fig. 206). When the telephones are installed on a single-conductor line (a ground-return circuit), the ends of the single conductor are connected to binding post L1 (or L2), and the other binding posts are connected to good grounds.

c. Modern Sound-Powered Handset. Figure 207 is an exploded view of a handset used with one of the commonly used sound-powered telephone systems. The transmitter and receiver units of the handset are not interchangeable. They are designed in such a way that they cannot be inserted in the wrong place, and they differ in the kind of acoustical openings placed over the diaphragm. Each unit is held in place by a plastic cap and retainer ring.

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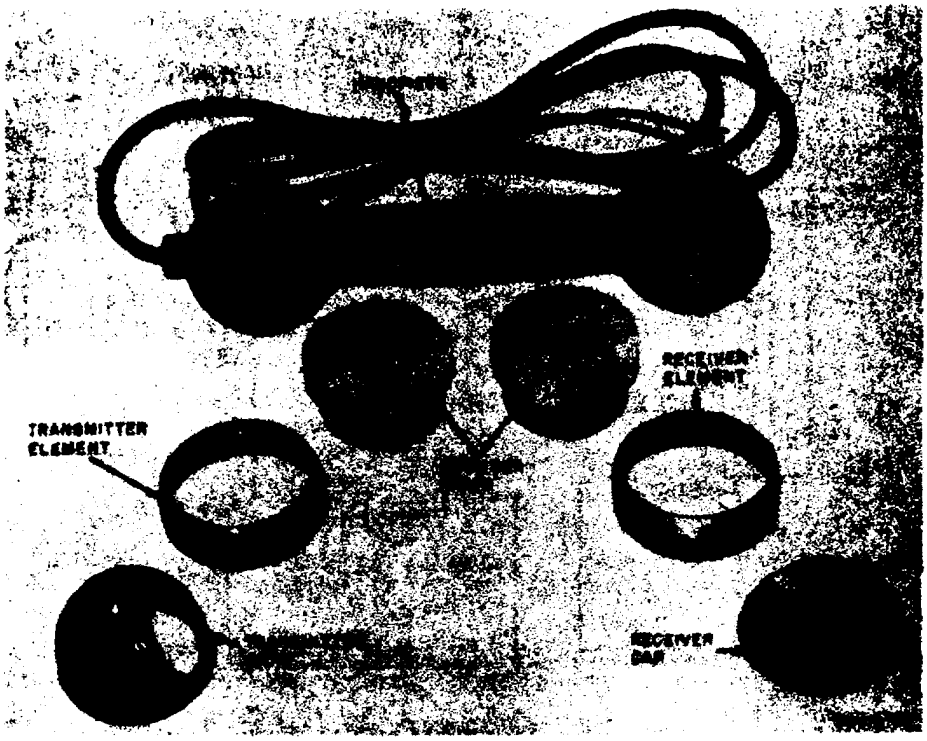

Figure 207. Exploded view of modern sound-powered handset.

176. Comparison of Battery- and Sound-Powered Telephone Systems

a. Advantages of Sound-Powered Telephone Systems. The most obvious advantage of sound-powered over battery-powered telephone systems is the fact that they do not require batteries or similar sources of power. This feature gives them applications which the other types do not have. Sound-powered systems possess other advantages, however. The transmitter and receiver units used in them usually are more rugged. They are less likely to produce distortion of the waveforms of the incident sound, and this makes the sound generated by the receiver a closer reproduction of the sound introduced at the transmitter. They have a better frequency response, which helps to improve the quality of the sound reproduced by the receiver. Finally, they are more compact, which is a decided advantage where portability is an important consideration.

b. Limitations of Sound-Powered Telephone Systems. The greatest limitation of sound-powered systems, and one which may outweigh all their advantages, is the relatively short distance over which they can be used. This limitation arises from the fact that the emf induced in the coil of the sound-powered transmitter is much smaller than the emf induced in the secondary of the induction coil in the carbon transmitter. For incident sounds of normal intensity, the induced emf is approximately 25 millivolts. This means that the current flowing in the transmitter coil is extremely small, and the current reaching the receiver coil is still smaller, because of the losses involved in transmission over wires. In order to reduce these losses to a degree that allows the current in the receiver coil to be sufficiently large to operate the receiver properly, the line length must be held to a minimum. This consideration restricts the use of sound-powered systems to distances of about 4 miles of Army field wire. One method of overcoming this limitation might be to speak more loudly, if possible; but this would overburden the speakers, and would be scientifically impractical, since it would make for greater distortion of the sound. Another method of overcoming the distance restriction would entail the use of amplifiers, but this would add to costs and remove the important advantage of portability. As long as a sound-powered system is operated within its limitations, satisfactory communication can be achieved.

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177. Summary

a. Sound-powered telephone systems provide a convenient means of communication, since they do not require batteries or other external sources of power.

b. Sound-powered transmitters operate on the same principle that governs the operation of electric generators. Sound waves, striking the diaphragm of the transmitter, cause it to vibrate. This vibration is transferred to an armature that moves within a magnetic field. When a coil is wound around the armature, the resulting vibration of the coil within the magnetic field causes an alternating emf to be induced in the coil.

c. When the sound-powered transmitter coil is connected to a sound-powered receiver by means of a transmission line, the alternating emf induced in the coil results in the flow of alternating current of similar waveform in the circuit.

d. The sound-powered receiver is an electromagnetic device. The alternating current flowing in the receiver coil sets up a varying magnetic field around the coil. This field interacts with the field of a permanent magnet and produces vibration of a soft-iron armature within the field. The vibration is transferred to a diaphragm, resulting in the reproduction of sound waves of similar waveform to the current in the coil.

e. Simple sound-powered systems consist of two identical units, one serving as the transmitter and the other as the receiver.

f. The more practical systems include provisions for signaling from one station to the other. They contain generators for producing the ringing current, and ringers for alerting personnel.

g. Besides the obvious advantage of not requiring external sources of power for their operation, sound-powered systems possess the additional advantage of more rugged components, better frequency response, and portability.

h. The chief limitation of sound-powered systems is the relatively small distance over which they may be operated. This is because the alternating emf induced in the transmitter coil is very small, resulting in correspondingly small currents in the coil of the receiver at the distant station.

178. Review Questions

a. What is meant by the term *sound-powered?*

b. Discuss briefly, with the aid of a diagram, the operating principle of the sound-powered transmitter.

c. On what factors does the magnitude of the emf induced in the coil of this type of transmitter depend?

d. Why is a soft-iron armature used in the sound-powered unit?

e. Under what condition will the emf induced in the coil of the transmitter cause a corresponding flow of current?

f. Discuss briefly, with the aid of a diagram, the operating principle of the sound-powered receiver.

g. Is the diaphragm used in the sound-powered receiver constructed of a magnetic material? Explain.

h. Explain why the same unit may be used as either transmitter or receiver in a sound-powered system.

i. Referring to figure 206, explain briefly the function of the following components: capacitor C1, screw switch S1, the generator switch, and capacitor C2.

j. Does the path containing the ringer offer a relatively high or low impedance to (1) voice currents, (2) ringing current? Explain.

k. Draw a block diagram of a simple sound-powered system.

l. What are some possible applications of sound-powered systems?

m. List some of the advantages of sound-powered systems over battery-powered systems.

n. What is the major limitation of sound-powered systems?

o. What are the objections to attempting to increase the distance over which sound-powered telephones can be used effectively by (1) speaking more loudly, (2) using amplifiers along the line?

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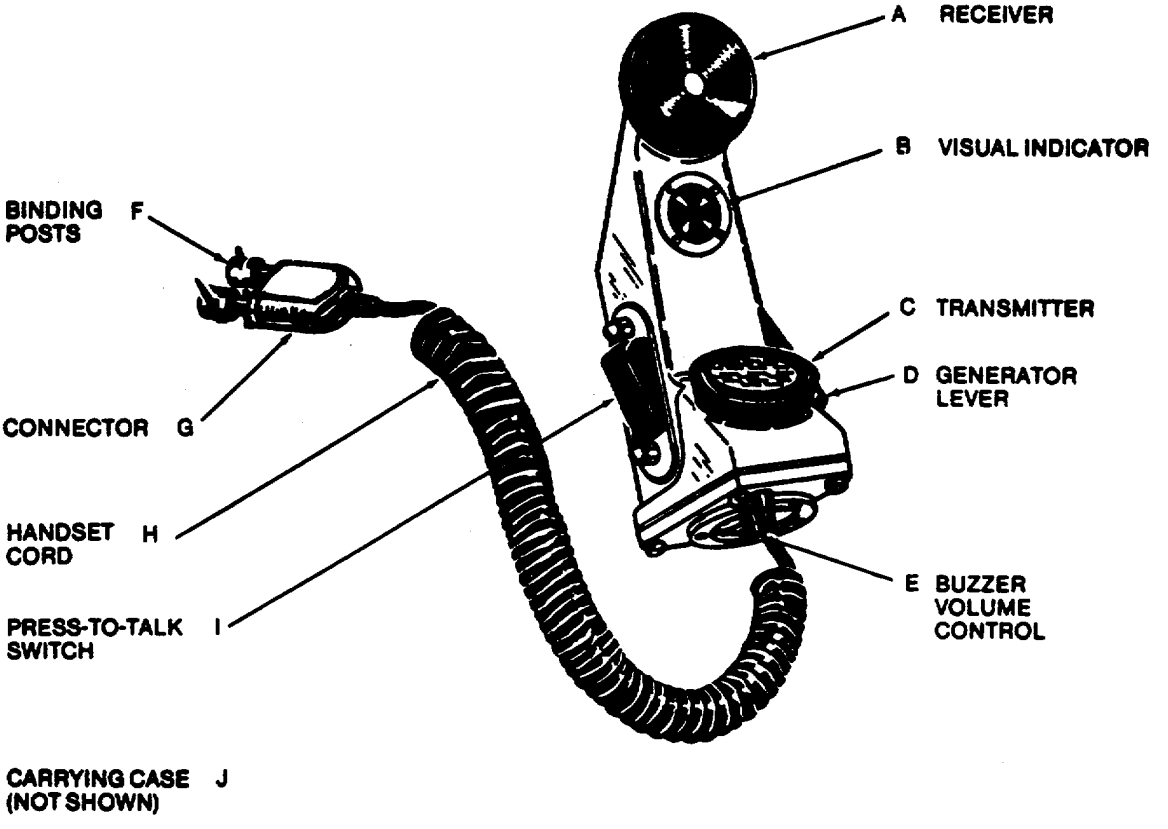
1-8. LOCATION AND DESCRIPTION OF MAJOR COMPONENTS



A RECEIVER. Provides earpiece for in-coming calls.
B VISUAL INDICATOR. Indicates present of in-coming calls.
C TRANSMITTER. Provides mouthpiece for out-going calls.
D GENERATOR LEVER. Signals distant party of intent-to-transmit.
E BUZZER VOLUME CONTROL. Adjusts volume of in-coming call, audible signal.
F BINDING POSTS. Provide manual, press-to-open, release-to-close field wire connection.
G CONNECTOR. Contains binding posts and retains handset cord.
H HANDSET CORD. Provides flexible contact between handset and field wire.
I PRESS-TO-TALK SWITCH. Opens transmission circuit.
J CARRYING CASE. Provides waterproof transport protection for handset.

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1-9. DIFFERENCES BETWEEN MODELS

Item	Order No. 24977-Phila-55	38695-Phila-56	21101-Phila-57	19629-Phila-58
Case	Rubberized, with zipper-closing (serial numbers 1 through 9300). Plastic, with hinged cover (serial numbers 9301 and higher).	Plastic, with hinged cover.	Plastic, with hinged cover.	Plastic, with hinged cover.
Telephone transmitter cap	Metal	Metal	Metal	Plastic
Telephone transmitter cushion (rubber)	Used	Used	Used	Not used
Telephone receiver cap	Metal	Metal	Metal	Plastic
Telephone receiver cushion (rubber)	Used	Used	Used	Not used
Press-to-talk switch contact assembly	Held together with more than one screw.	Held together with more than one screw.	Held together with more than one screw.	Held together with only one screw.
Binding Post Lockpost	Lockwashers provided.	Lockwashers provided.	Lockwashers provided.	Lockwashers not provided.
Generator Lever Assembly	Lockwashers not provided (S/N 1 through 5009).	Lockwashers provided.	Lockwashers provided.	Lockwashers provided.
Generator Contact Assembly	Held together with more than one screw.	Held together with more than one screw.	Held together with more than one screw.	Held together with only one screw.
Capacitor C1 connection	Connected between transmitter element MK1 and receiver element RE1 (S/N 1 through 209).	Connected between transmitter element MK1 and buzzer DS1.	Connected between transmitter element MK1 and buzzer DS1.	Connected between transmitter element MK1 and buzzer DS1.
Wiring	Wired according to note 2, para. 5-47.	Wired as shown (para. 5-47).	Wired as shown (para. 5-47).	Wired as shown (para. 5-47).

1-10. EQUIPMENT DATA

- VOICE TRANSMISSION RANGE ..... 4 miles using field wire WD-1/TT (approximate)
- SIGNAL RANGE ..... 4 miles using field wire WD-1/TT (approximate)
- FREQUENCY RANGE ..... 300 to 4000 Hz
- SIGNAL VOLTAGE ..... 65 to 80 Vac at 20 Hz
- OPERATING TEMPERATURE ..... −40 to +131°F

Quantity	Item	Dimensions (in.) Height	Depth	Width	Unit weight
1	Handset, including 1 Earphone Element TA-118/PT 1 Microphone Element TA-121/PT	9 (less cord)	4	3 1/4	2 3/4 lb
1	Telephone set case (rubberized) with carrying strap (Order no. 24977-Phila-55, Serial nos. 1 through 9300)	10	4 1/4	3 1/2	14 oz.
1	Telephone set case (plastic) with carrying strap (Order no. 24977-Phila-55, Serial nos. 9301 and higher, Order nos. 38695-Phila-56 and 21101-Phila-57)	9 5/8	3 9/16	5 1/8	11 1/2 oz
1	Telephone set case (plastic) with carrying strap (Order no. 19629-Phila-58)	10	4 1/4	3 1/2	9 oz.

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Section III. PRINCIPLES OF OPERATION

1-11. OPERATING PRINCIPLES

- The TA-1/PT Telephone Set must be removed from its carrying case and connected to a field wire network to be operable.
- Connection is simplified through the use of dual binding posts.
- To transmit a call, a press-to-activate switch is repeatedly pressed to generate a signal of intent to communicate with a distant party.
- The distant party acknowledges verbally.
- To transmit a message, a press-to-talk switch is pressed.
- The telephone is then used as a conventional phone would be used with the exception of the need to release the press-to-talk switch to permit the incoming message to be heard.
- Communication continues through the alternate pressing and releasing of the press-to-talk switch to speak or listen.
- To receive a call, a preset buzzer will sound and/or a visual indicator will show white on black.
- This signal is acknowledged verbally after pressing the press-to-talk switch.
- Communication continues through the alternate pressing and releasing of the press-to-talk switch to speak or listen.
- When use is temporarily discontinued, the telephone set is placed in a ready condition by resetting the visual indicator and the buzzer volume.
- To disconnect for transport, the field wire is removed from the binding posts, the telephone set placed into its carrying case, and the case secured against the weather through the use of a zipper or latch.

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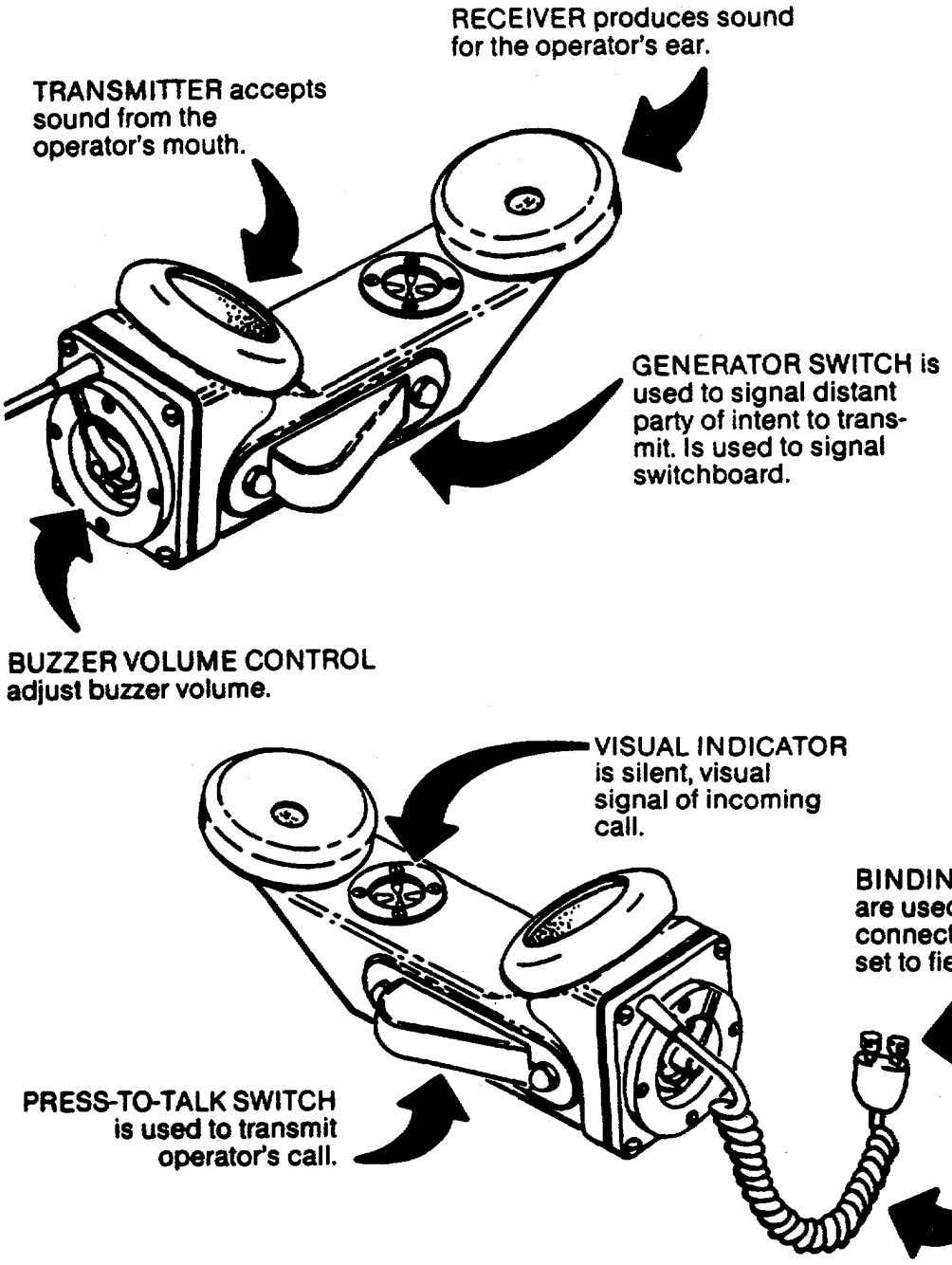
CHAPTER 2
OPERATING INSTRUCTIONS

Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS

2-1. GENERAL

Telephone Set TA-1/PT is a field communication device utilizing conventional phone principles of transmitting and receiving, except for the addition of specialized function switches, indicators, and controls.



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Section II. OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES

2-2. GENERAL

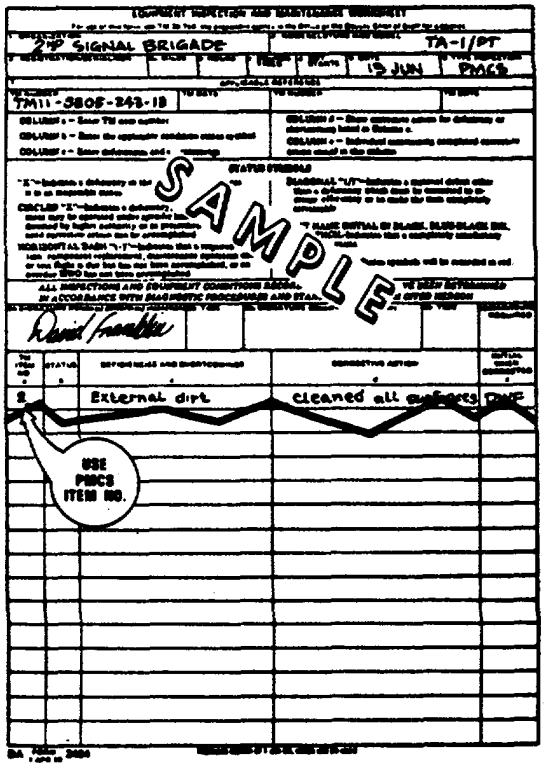
- Operator preventive maintenance is the systematic care, servicing and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to maintain equipment in serviceable condition. To be sure that your Telephone Set is always ready for your mission, you must do scheduled preventive maintenance checks and services (PMCS).

A BEFORE OPERATION, perform your B PMCS to be sure that your equipment is ready to go.

B DURING OPERATION, perform your D PMCS. This should help you to spot small troubles before they become big problems.

C When an item of equipment is reinstalled after removal, for any reason, perform the necessary B PMCS to be sure the item meets the readiness reporting criteria.

D Use the ITEM NO. column in the PMCS table to get the number to be used in the TM ITEM NO. column on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) when you fill out the form.



- Routine checks like stowing items not in use, and checking for loose nuts and bolts are not listed as PMCS checks. They are things that you should do any time you see they must be done. If you find a routine check like one of those listed in your PMCS, it is because other operators reported problems with this item.

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2-2. GENERAL – Continued

NOTE

- The PROCEDURES column in your PMCS charts instruct how to perform the required checks and services. Carefully follow these instructions.
- If your equipment must be in operation all the time, check those items that can be checked and serviced without disturbing operation. Make the complete checks and services when the equipment can be shut down.
- When you are doing any PMCS or routine checks, keep in mind the warnings and cautions.
- PMCS deficiencies that cannot be corrected must be reported to higher level maintenance level personnel. Records and reports of preventive maintenance must be made in accordance with procedures given in DA Pam 738-750.

Table 2-1. Operator Preventive Maintenance Checks and Services Chart

B – Before D – During

Item No.	Interval B	Interval D	Item to be Inspected	Procedures – Check for and have repaired or adjusted as necessary	Equipment is Not Ready/Available If:
1	*		Telephone Set TA-1/PT	Inspect Telephone Set for completeness and satisfactory condition. Perform functional test.	Any functional items are missing or in disrepair. Any component is inoperable.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately. Do not use compressed air to dry parts when TRICHLOROTRIFLUOROETHANE has been used.

2	•		External surfaces	Remove dirt and moisture from housing, handset, cord, or connector. Inspect painted surfaces for bare spots, rust, or corrosion. Inspect surfaces for cuts or cracks. Use cleaning compound, item 1, App. E.	Surfaces have excessive dirt, any corrosion, or damage.
3	•		Handset cord	Inspect cord for breaks, cuts or deterioration. Inspect for inoperative binding posts, broken connector, or handset connection.	Handset cord is missing or in disrepair.

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2-2. GENERAL – Continued

Table 2-1. Operator Preventive Maintenance Checks and Services Chart – Continued

B – Before D – During

Item No.	Interval B	Interval D	Item to be Inspected	Procedures – Check for and have repaired or adjusted as necessary	Equipment is Not Ready/Available If:
4	•		Press-to-talk switch	Inspect switch for binding or faulty action.	Switch is inoperative.
		•		Operate switch to engage or disengage remote party.	Switch malfunctions.
5	•		Generator switch	Inspect switch for binding or faulty action.	Switch is inoperative.
		•		Operate switch to signal remote party or switchboard.	Switch malfunctions.
6	•		Buzzer volume control	Inspect control for binding or faulty action.	Control is inoperable.
		•		Adjust volume from OFF to full volume. Volume should change.	Buzzer volume cannot be controlled.
7		•	Visual indicator	Visually confirm white areas during call signal generation.	Visual indicator does not show white when call signal exists.
				Reset visual indicator by pressing press-to-talk switch after call.	Visual indicator does not reset.
8		•	Transmitter	Ask remote party to qualify reception.	Transmitter malfunctions.
9		•	Receiver	Evaluate quality of reception.	Receiver malfunctions.
10	•		Carrying case	Inspect hinges and other hardware for functional quality. Confirm case seal is intact.	Carrying case will not protect handset and related components.

*Do this check before each deployment to a mission location. This will permit any existing problems to be corrected before the mission starts. The check does not need to be done again until redeployment.

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Section III. OPERATION UNDER USUAL CONDITIONS

2-3. GENERAL

Telephone Set TA-1/PT is a hand-held communications device requiring various combinations of manual functions to operate. It is not an independent device and requires initial connection to a field wire system.

2-4. CONNECTING TELEPHONE SET TO FIELD WIRE SYSTEM

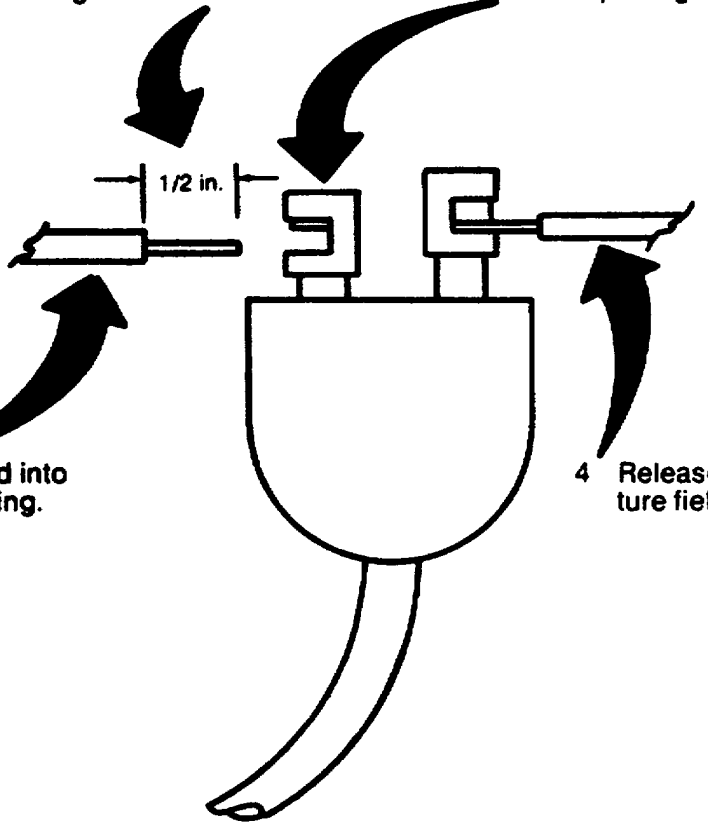
Connecting Telephone Set TA-1/PT to field wire WD-1/TT requires you to connect wire ends to the dual binding posts.

WARNING

- Wires may be live. Injury may result. Exercise extreme caution when handling electrical devices.
- Do not lay, place, or throw field wire on or near power lines or transformers. Dangerous high voltages exist at these structures. Severe shock or death may result from contact between field wire and power lines. Follow the five emergency steps for electric shock. Be careful when using TA-1/PT during storms. Lightning poses a shock hazard.

1 Strip field wire insulation to bare approximately 1/2 in. length of wire.

2 Press down on binding post to provide opening for field wire end.



3 Insert field wire end into binding post opening.

4 Release binding post to capture field wire end.

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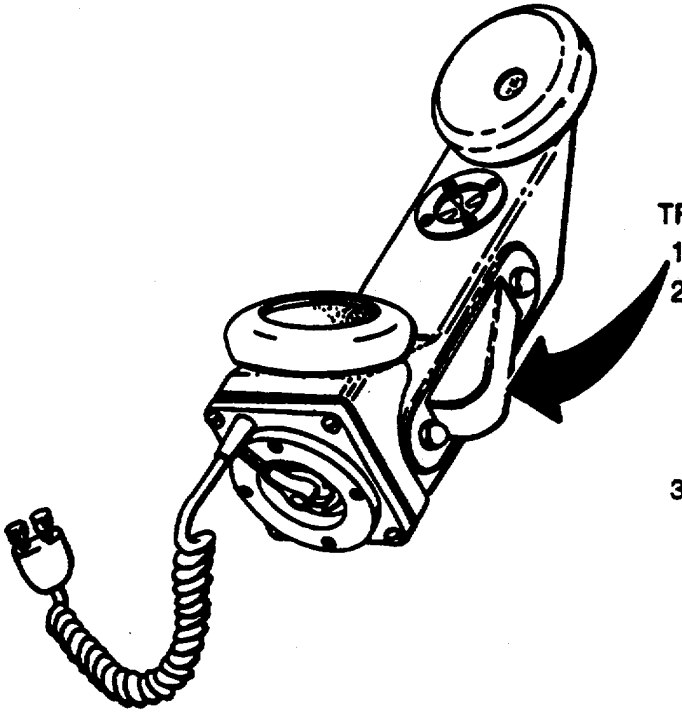
2-5. TRANSMITTING AND RECEIVING CALLS

Transmitting and receiving requires the use of finger activated switches. The telephone set should be held like a conventional phone, in either hand.



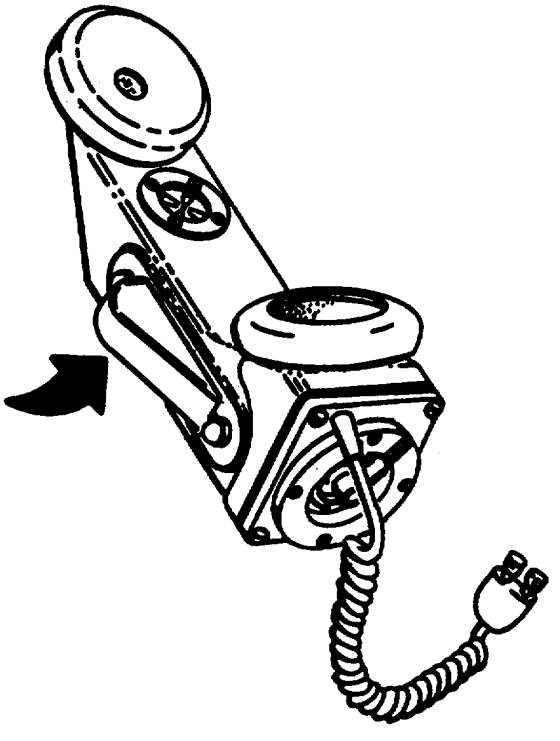
TRANSMIT CALLS:

1 Press generator lever rapidly and release.
2 Listen for distant party.

NOTE

Be certain press-to-talk switch is not depressed when listening.

3 When ready to talk, press press-to-talk switch firmly and speak directly into transmitter.



RECEIVE CALLS:

1 When buzzer sounds, or when visual indicator shows white markings, press press-to-talk switch and answer calling party.
2 Release press-to-talk switch to listen to distant party.

NOTE

To reset visual indicator, press press-to-talk switch.

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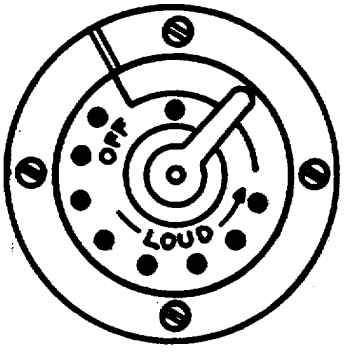
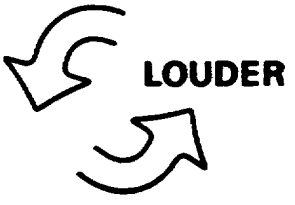
2-6. ADJUSTING BUZZER VOLUME



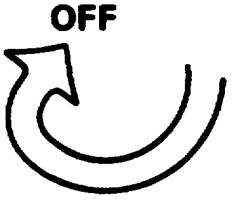
The buzzer volume control is located on the handset cord end of the telephone set.

A direction arrow indicates volume increase, and the off position is indicated by the word OFF.



Turn the buzzer volume control counterclockwise to make the buzzer louder.

Turn the buzzer volume control clockwise to make the buzzer softer.



Turn the buzzer volume control clockwise until it stops to prevent any buzzer sound.

NOTE

Be certain to set buzzer volume control to desired setting after each call is transmitted or received.

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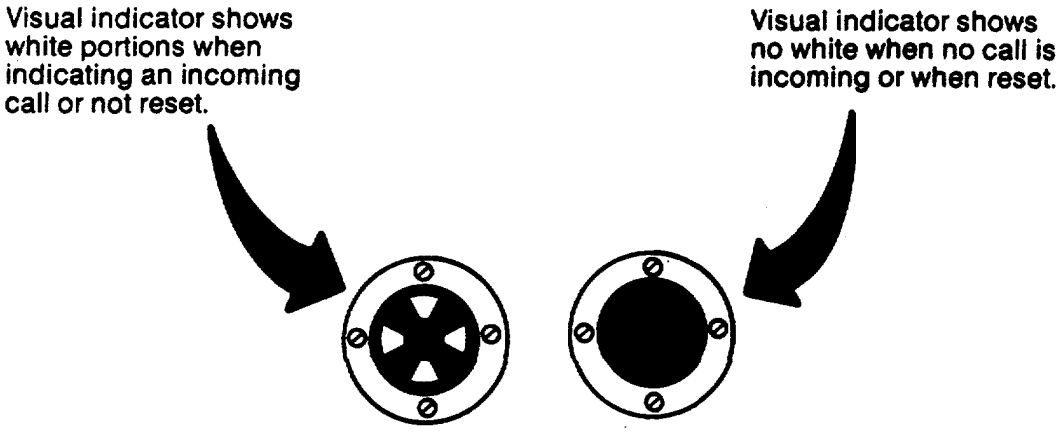
2-7. RESETTING VISUAL INDICATOR

To reset visual indicator press press-to-talk switch. Visual indicator should not show white portions when reset.



Section IV. OPERATION UNDER UNUSUAL CONDITIONS

2-8. EMERGENCY OPERATION

If the telephone set is not operating properly and an emergency arises before repairs can be made, follow the procedures below.

- If the transmitter is out of order, speak directly into the receiver. Do *not* press the press-to-talk switch. Listen at the receiver in the normal manner.
- If the receiver is out of order, speak into the transmitter in the normal manner. Listen at the transmitter and keep the press-to-talk switch depressed while listening as well as transmitting.

2-9. OPERATING IN COLD CLIMATES

Extreme cold reduces the transmission efficiency of the handset. Protect the handset from extreme cold as much as possible.

- The headset cord, the rubber covers on the generator lever and on the press-to-talk switch, and the rubberized case (when used) will become stiff in extreme cold; handle the telephone set carefully to prevent these items from cracking or breaking.
- If the moisture-preventing diaphragms are not in place on the transmitter or receiver, or if they are damaged, remove any moisture or ice from the affected part and cover the transmitter or receiver with a clean cloth.

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2-10. OPERATING IN HOT, DRY CLIMATES

- Protect the telephone set from dust, dirt, and direct sunlight.
- Keep the case closed to keep dust and dirt out of the equipment.

2-11. OPERATING IN WARM, DAMP CLIMATES

- Keep all exterior parts of the telephone set free from moisture and fungus. Clean with a lint-free cloth.
- If the moisture-preventing diaphragms are not in place on the transmitter or receiver, or if they are damaged, remove any accumulated moisture or material and cover the transmitter or receiver with a clean cloth.

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CHAPTER 5
INTERMEDIATE DIRECT SUPPORT MAINTENANCE

Section I. INTRODUCTION

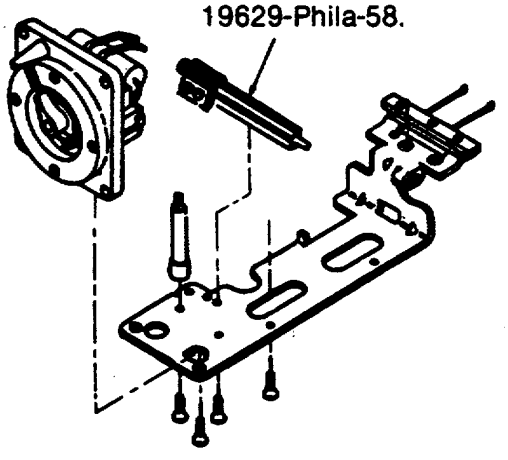
5-1. GENERAL

All troubleshooting and repair is assigned to the Intermediate Direct Support Maintenance level. This maintenance level is the highest approved for the TA-1/PT Telephone Set.

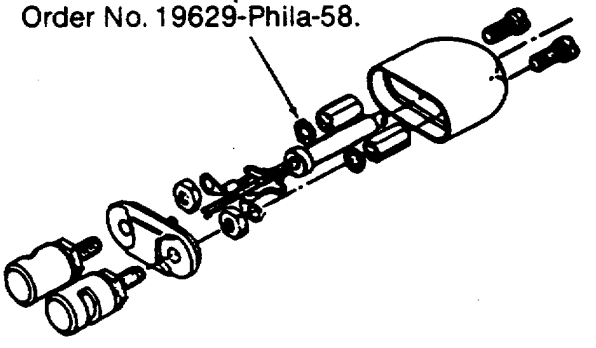
5-2. INTERNAL VARIATIONS

There are internal differences which characterize different models. These differences are as follows:

1 Press-to-talk switch contact assembly is held together with one screw on Order No. 19629-Phila-58.

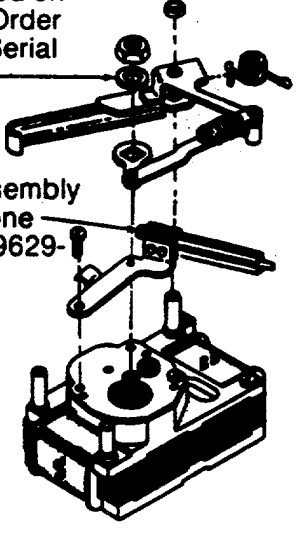


2 Lockwasher not provided on Order No. 19629-Phila-58.

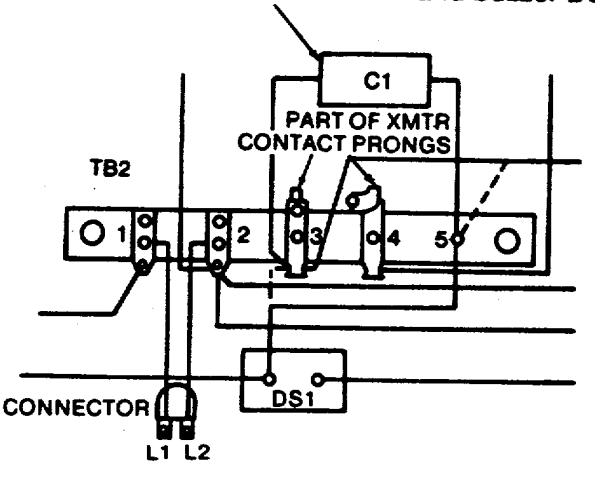


3 Lockwasher is not used on equipments bearing Order No. 24977-Phila-55, Serial No. 1 through 5009.

4 Generator contact assembly is held together with one screw on Order No. 19629-Phila-58.



5 24977-Phila-55 (Serial No. 1 through 209). Capacitor C1 is connected between transmitter element MK1 and receiver element RE1. On all other equipments, capacitor C1 is connected between transmitter element MK1 and buzzer DS1.



6 On equipments bearing Order No. 24977-Phila-55, Serial Nos. 1 through 209, wires are connected as shown by dashed lines.

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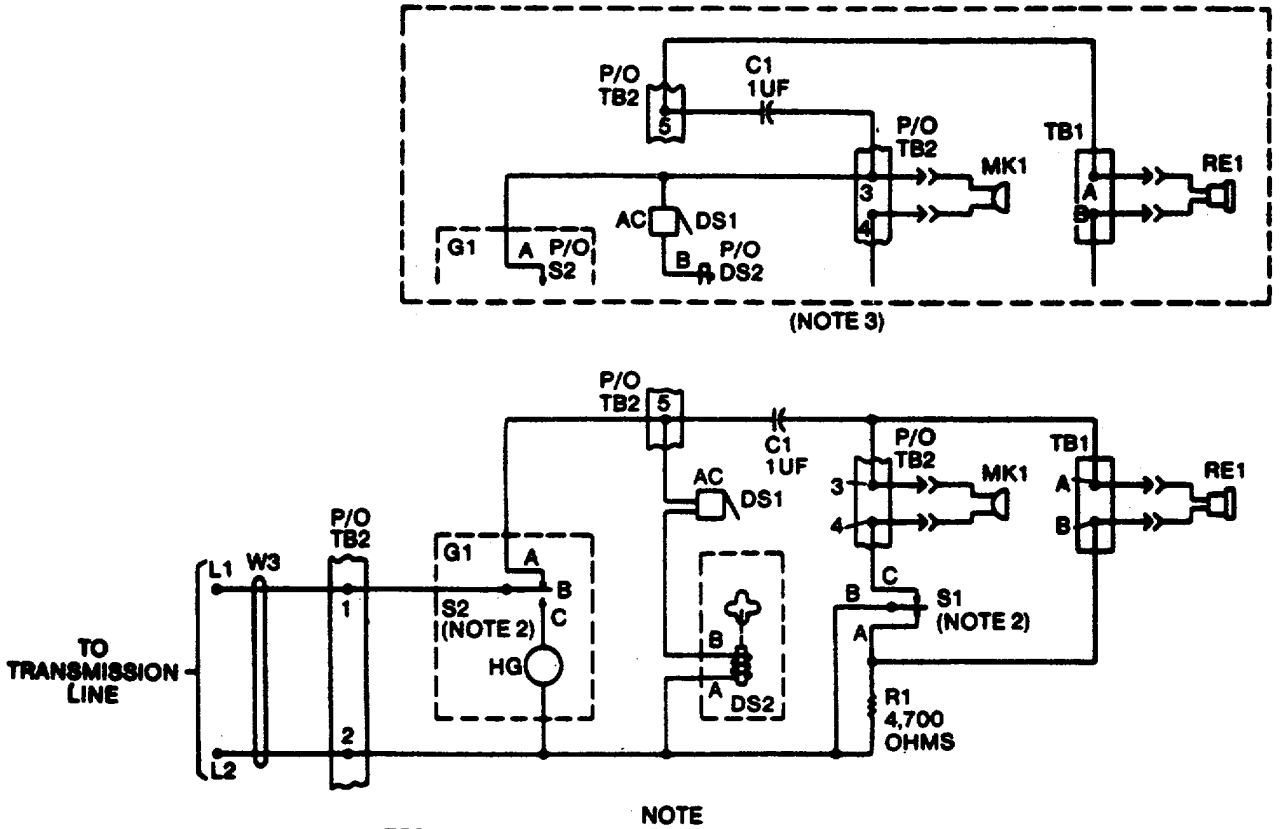
Section II. SCHEMATIC DIAGRAM ANALYSIS

5-3. GENERAL

Schematic diagram analysis is provided to better acquaint you with Telephone Set TA-1/PT operating theory. The schematic diagram is shown below.



NOTE

1. TERMINAL LETTER OR NUMBER DESIGNATIONS ARE ASSIGNED ARBITRARILY FOR REFERENCE PURPOSES.
2. GENERATOR SWITCH S2 AND PRESS-TO-TALK SWITCH S1 SHOWN IN NONOPERATED POSITION.
3. CAPACITOR C1 IS CONNECTED AS SHOWN ON EQUIPMENTS BEARING ORDER NO. 24977-PHILA-55. SERIAL NOS. 1 THROUGH 209.

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5-4. OUTGOING SIGNAL

- When the generator lever is depressed, its initial motion actuates generator switch S2. The switch opens the circuit between line terminal L1 and buzzer DS1, the transmitting and the receiving circuits, and closes the circuit between line terminal L1 and genertor G1. As the generator lever moves downward, it rotates the hand-generator rotor. This rotation generates 20 Hz ac at 65 to 80 volts, which is impressed across line terminals L1 and L2.

- When the generator lever is released, the lever, which is spring-loaded, springs back freely without turning the generator rotor. As the generator lever returns to its normal position, the spring contacts of the generator switch open the circuit between line terminal L1 and generator G1, and close the circuit between line terminal L1 and buzzer DS1, the transmitting, and the receiving circuits.

5-5. INCOMING SIGNAL

- The incoming ac signaling current from the distant telephone or switchboard, passes through the normally closed contacts (A and B) of generator switch S2, and flows through buzzer DS1 and visual indicator DS2. The incoming signaling current is blocked from the receiving and transmitting circuits by capacitor C1, whioh offers high impedance to 20 Hz current, and low impedance to voice-frequency currents.

- As the 20 Hz signaling current passes through the coil of buzzer DS1, the armature of the buzzer is alternately magnetized. As the armature is magnetized in opposite directions, it vibrates between the poles of a permanent magnet and strikes against the buzzer diaphragm, producing the signaling sound.

- The buzzer volume is mechanically controlled by a screw attached to the buzzer volume control knob. The screw moves in or out to vary the distance through which the buzzer armature can vibrate. This action varies the force with which the armature strikes the diaphragm, and thereby determines the loudness of the buzzer sound. When the buzzer volume control knob is in the OFF position, the armature is clamped tight, so that it cannot vibrate; therefore, no sound can be produced.

- As the signaling current passes through the coil of visual indicator DS2, a magnetic field is produced. The magnetic field rotates the armature to a position where its markings can be seen through openings in the top of the visual indicator. The armature is held in the operated position by a small permanent magnet attached to an arm that is linked to the press-to-talk switch. When the press-to-talk switch is pressed, the arm and its permanent magnet are moved away from the armature. The armature, which is spring-loaded, rotates back to the nonoperated position.

5-6. VOICE TRANSMISSION

- When press-to-talk switch S1 is depressed, contacts B and C connect to complete the transmitting circuit. Contacts B and A open to insert limiting resistor R1 in series with the receiver element.

- When voice sound waves strike the diaphragm in transmitter element MK1, the armature is actuated in the transmitter element. An alternating current, at the same frequency as that of the voice sound waves, is generated. Most of the generated current is transmitted over the transmission line through contacts BC of switch S1 and contacts BA of switch S2. A small portion of the generated current (limited by resistor R1) passes through the receiver element to produce a small amount of *sidetone* during voice transmission, so that the telephone set will not sound dead. Capacitor C1 has a low impedance to voice frequencies.

- The transmitter current is prevented from passing through the buzzer and visual indicator circuit by the inductance of the windings of the buzzer and the visual indicator, which offer a high impedance to voice frequencies.

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5-7. VOICE RECEPTION

- The incoming voice signal passes through the normally closed contacts (A and B) of generator switch S2, through capacitor C1, receiver element RE1, and through the normally closed contacts (B and A) of press-to-talk switch S1.
- As the incoming voice signal passes through the receiver element, it actuates the receiver armature and, in turn, causes the receiver diaphragm to vibrate, thereby reproducing the voice of the distant party.

Section III. REPAIR PARTS, TOOLS, AND TEST EQUIPMENT

5-8. REPAIR PARTS

Repair parts will not be procured. Repair by Controlled Exchange is authorized. If Telephone Set TA-1/PT cannot be repaired through Controlled Exchange of major components and modules between like failed end items, then the complete end item should be ordered.

5-9. TOOLS

The following tool kits should be used:

Nomenclature	NSN
Electronic Equipment Tool Kit, TK-101/G	5180-00-064-5178
Electronic Equipment Tool Kit, TK-105/G	5180-00-610-8177

For authorized common tools and equipment refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

5-10. TEST EQUIPMENT

The following test equipment should be used:

Nomenclature	NSN
Telephone Test Set, AN/PTM-6	6625-00-229-1048
Multimeter, TS-352B/U	6625-00-553-0142
Digital Multimeter, AN/PSM-45 (When issued, replaces Multimeter, TS-352B/U)	6625-01-139-2512

Section IV. TROUBLESHOOTING

5-11. USE OF TROUBLESHOOTING TABLE

Table 5-1 contains troubleshooting information useful to maintenance technicians in diagnosing and correcting malfunctions or unsatisfactory operation of the TA-1/PT.

- The troubleshooting table lists the common malfunction symptoms and unsatisfactory performance characteristics technicians are most likely to encounter; test and inspection steps to be followed to determine the cause, and the corrective action(s) that should be performed for each possible cause listed.
- The technician should first find the malfunction symptom or unsatisfactory performance characteristic in the table which most closely describes the immediate situation; then perform the test and inspections, and corrective action steps in the order in which they are listed.
- This manual cannot list all possible situations which may be encountered, nor can it list all test and inspection, and corrective action steps which may be taken.

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5-11. USE OF TROUBLESHOOTING TABLE – Continued

Table 5-1. Troubleshooting

Malfunction	Probable cause	Corrective action
Binding post will not hold line wire firmly.	Defective binding post.	Replace binding post (para 5-17).
Buzzer volume control knob does not move freely.	Defective buzzer volume control.	Replace buzzer volume control (para 5-22).
	Defective buzzer.	Replace buzzer (para 5-23).
Cannot signal distant party.	Defective generator switch contact assembly.	Clean contact assembly, and burnish contacts, if necessary.
		Adjust generator switch contact springs (para 5-33).
		Replace generator switch contact assembly (para 5-30).
	Defective generator.	Check resistance (para 5-12). Replace generator (para 5-28) if necessary.
	Defective generator lever.	Replace lever (para 5-29).
Generator lever will not return to normal position when released.	Defective generator lever.	Replace lever (para 5-29).
Buzzer will not sound.	Buzzer out of adjustment.	Adjust buzzer (para 5-34).
	Defective buzzer diaphragm.	Replace buzzer diaphragm (para 5-23).
	Defective buzzer.	Check resistance (para 5-12). Replace buzzer (para 5-23) if necessary.
Visual indicator will not operate.	Defective visual indicator.	Check resistance (para 5-12). Replace visual indicator (para 5-26) if necessary.
Moisture-preventing diaphragms do not eliminate receiver or transmitter moisture.	Defective moisture-preventing diaphragms.	Replace receiver or transmitter moisture-preventing diaphragms (para 4-15).
Visual indicator will not stay in operated position.	Defective visual indicator mechanism.	Replace visual indicator mechanism (para 5-26).
Visual indicator will not return to nonoperated position when press-to-talk switch is pressed.	Defective visual indicator mechanism.	Replace lever assembly (para 5-27).
	Defective visual indicator mechanism (para. 5-26).	Replace lever assembly (para 5-27).
Incoming 20 Hz signal heard loudly in receiver, visual indicator and buzzer do not operate.	Capacitor C1 shorted.	Check resistance (para 5-12). Replace capacitor (para 5-20).
Cannot hear sidetone in receiver when talking to distant party.	Resistor R1 open.	Check resistance (para 5-12). Replace resistor (para 5-21).

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5-11. USE OF TROUBLESHOOTING TABLE – Continued

Table 5-1. Troubleshooting – Continued

Malfunction	Probable cause	Corrective action
Cannot talk to distant party.	Defective transmitter element.	Check resistance (para 5-12). Replace transmitter element (para 5-15) if necessary.
	Defective press-to-talk switch contact assembly.	Clean contact assembly, and burnish contacts, if necessary. Adjust contact springs (para 5-32). Replace contact assembly (para 5-25).
	Defective press-to-talk lever assembly.	Replace lever assembly (para 5-27).
Press-to-talk switch will not return to listen position when released.	Defective press-to-talk lever assembly.	Replace lever assembly (para 5-27).
Cannot hear distant party.	Defective receiver element.	Check resistance (para 5-12). Replace receiver element (para 5-16) if necessary.
	Defective press-to-talk switch contact assembly.	Clean contact assembly, and burnish contacts, if necessary. Adjust contact springs (para 5-32). Replace contact assembly (para 5-25).
	Defective press-to-talk lever assembly.	Replace lever assembly (para 5-27).
	Capacitor C1 open.	Check capacitor C1. Replace capacitor (para 5-20) if necessary.
Cannot send or receive 20 Hz signaling. Cannot send or receive voice.	Defective handset cord.	Check continuity. Replace handset cord (para 5-18) if necessary.
	Loose connection of handset cord.	Remove the cover from the connector (para 5-18) and check to see that the terminal lugs are properly secured. Replace connector cover. Remove the chassis (para 4-14) from the handset housing and check to see that the handset cord terminal lugs are properly secured to the terminal board. Install the chassis (para 4-14) in the handset housing.
	Defective generator switch contact assembly.	Clean contact assembly, and burnish contacts if necessary. Adjust contact springs (para 5-33).
	Defective terminal board.	Replace terminal board TB2 (para 5-19).
	Defective press-to-talk switch contact assembly.	Replace contact assembly (para 5-25).

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5-11. TROUBLESHOOTING – Continued

Table 5-1. Troubleshooting – Continued

Malfunction	Probable cause	Corrective action
Buzzer volume control will not vary buzzer volume from no sound to loud sound. Fails receiving efficiency test (para 5-41).	Buzzer out of adjustment. Defective buzzer volume control. Receiver cap may be of the type having a raised inside surface which may bear against the receiver element causing reduced sensitivity.	Adjust buzzer (para 5-34). Replace buzzer volume control (para 5-22). Remove the receiver cap and examine the inside surface. If it is of the type described, install a cork gasket (thickness about the same as the gasket on the moisture preventing diaphragm) next to the receiver element to **act as a spacer. Reinstall the receiver cap with diaphragm. Retest. If unit still fails test, replace cap (para 4-15).**

5-12. RESISTANCE MEASUREMENT

Use multimeter to check for shorts or opens. Dc resistances of the telephone set are as follows:

WARNING

Do not attempt to make internal connections or adjustments unless another person, capable of performing first aid, is present.

Measure point	Resistance (ohms)
Between line terminals L1 and L2 (chassis removed from housing)	1,520
Between line terminals L1 and L2 (generator lever fully depressed *before* applying test leads).	1,850
Across receiver element RE1 (removed from housing)	65 (click is heard)
Across transmitter element MK1 (removed from housing)	60 (click is heard)
Between terminals A and B of visual indicator coil DS2	720
Across buzzer DS1	800
Between terminals A and B of each generator coil	940 each
Between terminal A of visual indicator coil DS2 and receiver contact prong B (press-to-talk switch depressed)	4,700

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Section V. INTERMEDIATE DIRECT SUPPORT MAINTENANCE PROCEDURES

5-13. HOW TO USE THIS SECTION

- Removal steps are first, followed by replacement steps. Numbers in circles are listed in consecutive order before each written step. Numbers in circles on the supporting artwork match the written step and call for that area of the assembly to be removed or replaced. Numbers in circles that indicate removal may also be coupled with a number indicating replacement. Some numbers in circles before a written step may not be found on the art. This means the task needs no reference, or the written step will carry a reference in parentheses indicting another area in the manual.

- Written steps should be read consecutively to properly understand task. Circled numbers on artwork are for reference only. Notes will be found within written tasks and also within the artwork. Cautions will be within written steps only. Various graphic indicators have been added to artwork to visually assist you.

WARNING

- Before removing any components, be certain there is no power connected to binding posts. Injury could result.

- Adequate ventilation should be provided while using TRICHLOROTRIFLUORO-ETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penet-rate. If the solvent is take internally, consult a physician immediately. Do not use com-pressed air to dry parts when TRICHLOROTRIFLUOROETHANE has been used.

5-14. REPLACEMENT PROCEDURES

Replacement procedures show remove and replace steps supported by illustrations. All primary remove-and-replace procedures are shown in this section except for chassis removal, paragraph 4-14, and moisture-preventing diaphragms, paragraph 4-15, accomplished at the Unit Maintenance level.

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5-15. REPLACEMENT OF TRANSMITTER ELEMENT

• REMOVAL

CAUTION

The transmitter cushion (if provided), the transmitter cap and the moisture-preventing diaphragm will separate from the handset as a single unit. Remove the transmitter cap carefully so that the remaining parts do not fall out.

1 Hold the handset in one hand and unscrew the transmitter cap.

2 Remove the transmitter resonator and the transmitter resonator support.

3 Remove the transmitter element.

4 Remove the gasket from the transmitter element.

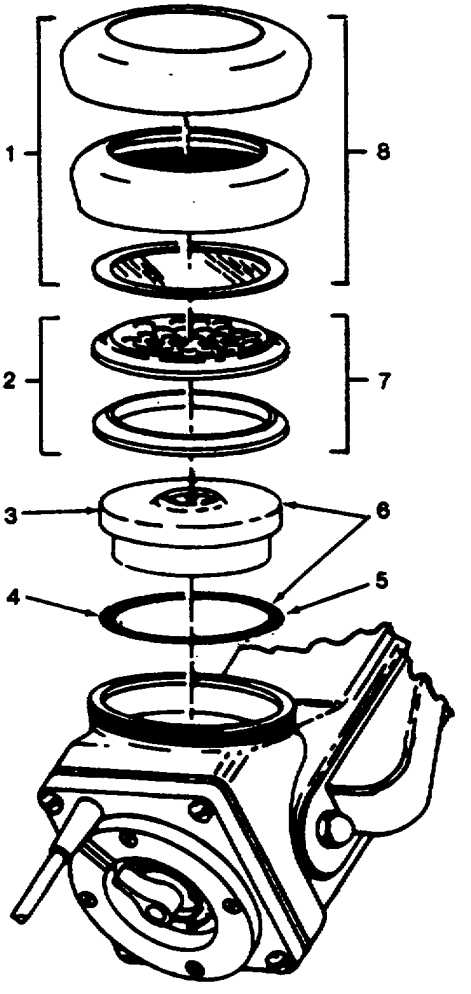
• REPLACEMENT

5 Place the gasket on the replacement transmitter element.

6 Hold the handset in one hand and replace the transmitter element and the gasket.

7 Replace the transmitter resonator support and the transmitter resonator.

8 Position the transmitter cap over the parts already in place, and screw the transmitter cap to the handset.



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5-16. REPLACEMENT OF RECEIVER ELEMENT

• REMOVAL

CAUTION

The receiver cushion (if provided), the receiver cap and the moisture-preventing diaphragm will separate from the handset as a single unit. Remove the receiver cap carefully so that receiver element and the gasket do not fall out.

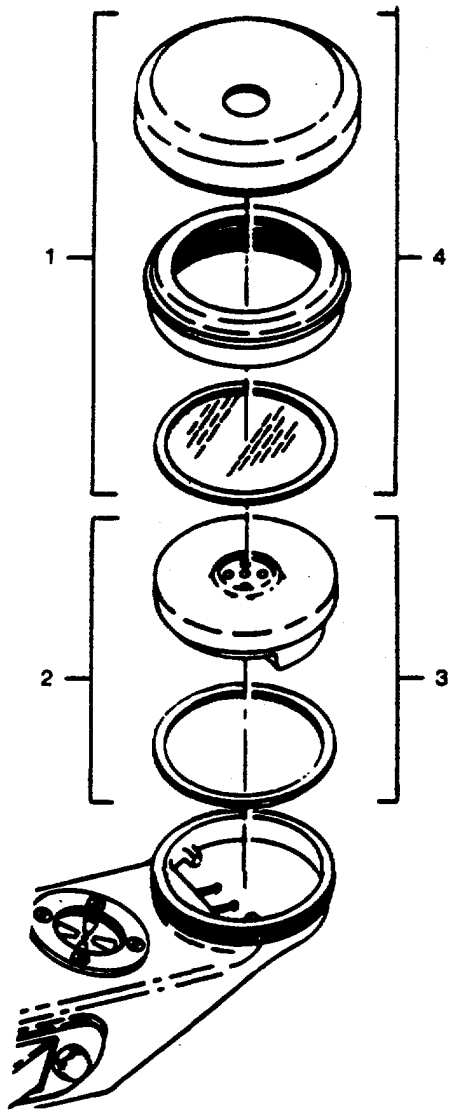
1 Hold the handset in one hand and unscrew the receiver cap.

2 Remove the receiver element and the gasket from the handset.

• REPLACEMENT

3 Lay the handset on a level surface. Replace the gasket and place the replacement receiver element in the handset.

4 Position the receiver cap over the parts already in place, and screw the receiver cap to the handset.



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5-17. REPLACEMENT OF BINDING POSTS

• REMOVAL

1 Remove the two screws from the connector cover.

2 Slide the connector cover along the handset cord far enough to expose the mounting plate.

3 Remove the mounting posts and the lock-washers (not provided on Order No. 19629-Phila-58).

4 Remove the terminal lugs from the threaded studs of the binding posts.

5 Remove the hexagonal nuts and the binding posts from the binding post board.

• REPLACEMENT

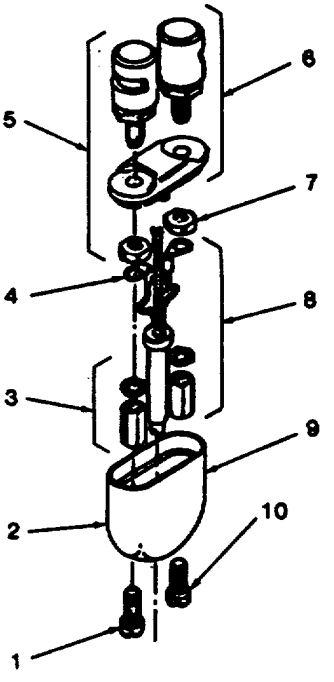
6 Replace the binding posts on the binding post board with the slots in the binding posts outward.

7 Replace the hexagonal nuts on the threaded studs of the binding posts.

8 Place the terminal lugs on the threaded studs of the binding posts, and replace the lock-washers (not provided on Order No. 19629-Phila-58) and the mounting posts.

9 Slide the connector cover onto the rubber sleeve and pull the rubber sleeve outward until its flange rests against the inside of the connector cover; set the cover against the binding post board ensuring the tie-cord does not stick out between the connector cover and the binding post board.

10 Replace the two screws.



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5-18. REPLACEMENT OF HANDSET CORD

• REMOVAL

1 Remove the two screws from the connector cover.

2 Slide the connector cover along the handset cord far enough to expose the mounting posts.

3 Remove the mounting posts and the lockwashers (not provided on Order No. 19629-Phila-58).

4 Remove the terminal lugs from the threaded studs of the binding posts.

5 Untie the tie-cords from the binding post board.

6 Pull the disconnected end of the handset cord through the rubber sleeve and remove the cord and the sleeve from the connector cover.

7 Remove the chassis (para 4-14) from the handset housing.

8 Loosen the capacitor clamp nut (not shown) and rotate the capacitor and clamp to gain access to the terminal board.

9 Disconnect the two handset cord terminal lugs from the terminal board.

10 Untie the tie-cords from the stud on the terminal board.

11 Pull the end of the handset cord through the rubber sleeve.

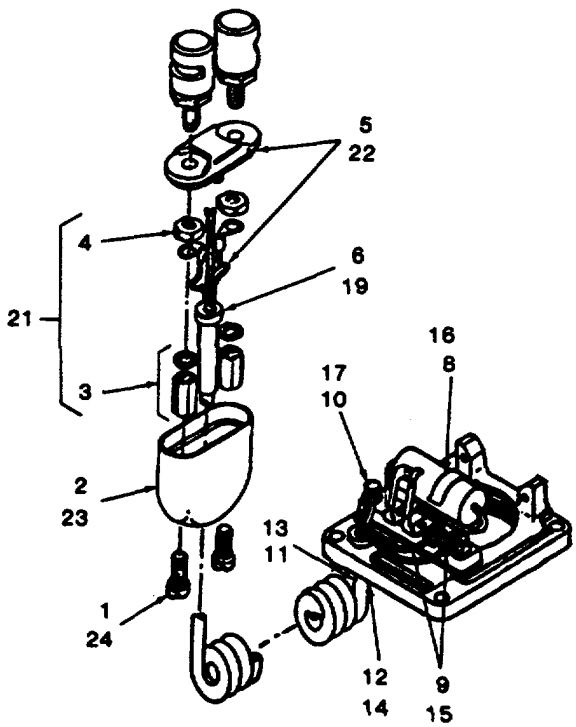
12 Push the rubber sleeve up through the hole in the chassis base.

• REPLACEMENT

13 Insert the end of the handset cord that has the small terminal lugs through the hole in the bottom of the chassis base and then through the rubber sleeve.

14 Pull the rubber sleeve outward through the hole in the bottom of the chassis until the flange on the sleeve rests firmly against the inside of the bottom of the chassis base.

15 Reconnect the two handset cord terminal lugs to the terminal board.



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5-18. REPLACEMENT OF HANDSET CORD – Continued

• REPLACEMENT - Continued

16 Switch the capacitor and the clamp down until they are parallel with the terminal board, and tighten the capacitor clamp nut.

17 Tie the two tie-cords to the tie-cord stud on one end of the terminal board so there will be no tension on the handset cord leads.

18 Replace the chassis (para 4-14) in the handset housing.

19 Insert the other end of the handset cord through the center hole in the connector cover and then through the rubber sleeve.

20 Bend the two terminal lugs into right angles.

21 Place the two terminal lugs on the threaded studs of the binding posts and replace the lockwashers (not provided on Order No. 19629-Phila-58) and the mounting posts.

22 Tie the tie-cords to the binding post board so there will be no tension on the handset cord leads.

23 Slide the connector cover onto the rubber sleeve and pull the rubber sleeve outward until its flange rests against the inside of the connector cover; set the cover against the binding post board ensuring the tie-cord does not stick out between the connector cover and the binding post board.

24 Replace the two screws.

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5-19. REPLACEMENT OF TERMINAL BOARD

• REMOVAL

1 Remove the chassis (para 4-14) from the handset housing.

2 Untie the tie-cords from the tie-cord stud.

3 Unsolder the bare capacitor lead from the stud on the terminal board.

4 Loosen the capacitor clamp nut and rotate the capacitor and the clamp to gain access to the terminal board.

5 Tag the transmitter contact to which the other capacitor lead is soldered and unsolder the lead.

6 Remove the capacitor clamp nut, the clamp, and the capacitor.

7 Disconnect the handset cord terminal lugs from the terminal board.

8 Tag each lead connected to the terminal board and unsolder the leads.

9 Unscrew the tie-cord stud and the screw that secures the terminal board to the chassis base.

10 Remove the terminal board from the chassis base.

• REPLACEMENT

11 Secure the replacement terminal board to the chassis base. The tie-cord stud secures the side of the terminal board nearest the rubber sleeve.

12 Resolder the leads to the terminal board.

13 Reconnect the handset cord terminal lugs to the terminal board.

14 Replace the capacitor, the capacitor clamp, and the capacitor clamp nut.

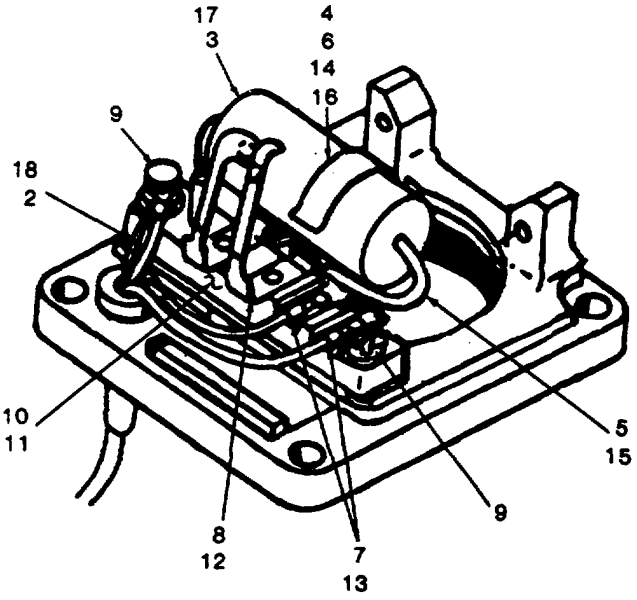
15 Solder the insulated capacitor lead to the transmitter contact.

16 Swing the capacitor and the clamp down until they are parallel with the terminal board, and tighten the capacitor clamp nut.

17 Resolder the base capacitor lead to the stud on the terminal board.

18 Tie the tie-cords to the tie-cord stud so there will be no tension on the handset cord leads.

19 Replace the chassis (para 4-14) in the handset housing.



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5-20. REPLACEMENT OF CAPACITOR C1

• REMOVAL

1 Remove the chassis (para 4-14) from the handset housing.

2 Unsolder the bare capacitor lead from the stud on the terminal board.

3 Loosen the capacitor clamp nut (not shown) and rotate the capacitor and the clamp to gain access to the terminal board.

4 Tag the transmitter contact to which the other capacitor lead is soldered and unsolder the lead.

5 Remove the capacitor from the capacitor clamp.

• REPLACEMENT

6 Cut the leads on the new capacitor to the same length as the leads on the capacitor that was removed.

7 Place a piece of insulating tubing on the long capacitor lead.

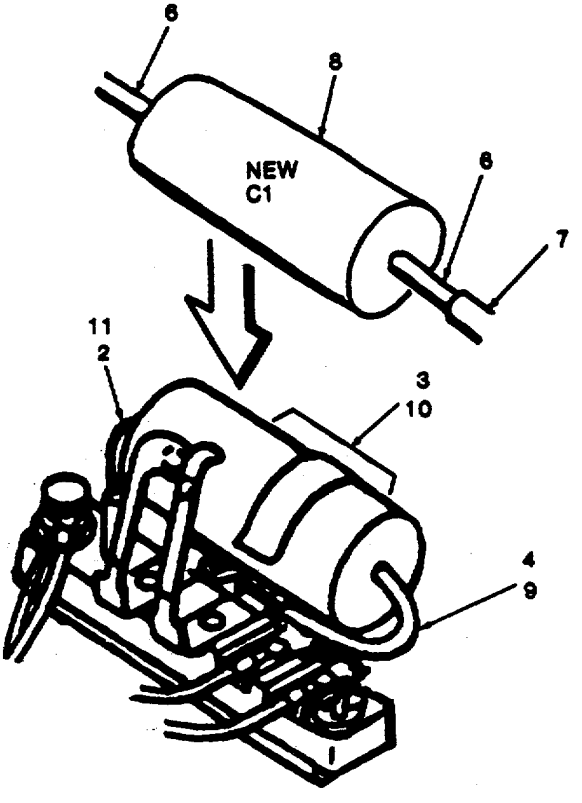
8 Place the new capacitor in the capacitor clamp.

9 Solder the insulated capacitor lead to the tagged transmitter contact.

10 Rotate the capacitor and the capacitor clamp until they are parallel to the terminal board and tighten the capacitor clamp nut.

11 Solder the bare capacitor lead to the stud on the terminal board.

12 Replace the chassis (para 4-14) in the handset housing.



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5-21. REPLACEMENT OF RESISTOR R1

• REMOVAL

1 Remove the chassis (para 4-14) from the handset housing.

2 Tag the receiver contact prong to which a resistor lead is soldered. Unsolder the lead.

3 Loosen the screw.

4 Move the magnet pole piece away from the core of the visual indicator coil. Carefully move the visual indicator coil to gain access to the coil terminals.

5 Tag the lead that connects to the same terminal of the visual indicator coil as the resistor. Unsolder resistor lead.

• REPLACEMENT

6 Cut the leads of the new resistor to the same length as the leads of the resistor that was removed.

7 Place a piece of insulating tubing on the long resistor lead.

8 Solder the insulated resistor lead to the terminal on the visual indicator coil that is indicated by the tagged lead.

9 Place the ends of the core of the visual indicator coil in the slots in the magnet pole pieces and tighten the loosened screw.

10 Solder the other resistor lead to the receiver contact prong that is indicated by the tag.

11 Replace the chassis (para 4-14) in the handset housing.